N00217_002813
NS HUNTERS POINT, CA
SSIC 5000-33c

DRAFT AIR SAMPLING REPORT

01/02/1992
HARDING LAWSON ASSOCIATES

A Report Prepared for

Installation Restoration Branch, Code 1811
Western Division
Naval Facilities Engineering Command
900 Commodore Drive, Building 101
San Bruno, California 94066

DRAFT
AIR SAMPLING REPORT
NAVAL STATION, TREASURE ISLAND
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA

CONTRACT NO. 5086-90-057-004, CTO 57

HLA Job No. 18639,079.02

by

Paul A. Dawson
Industrial Hygiene Technician

Chris Corpuz, C.I.H.
Associate Industrial Hygiene
and Safety Specialist

Robert Vranka, Ph.D
Principal Environmental Scientist

Ashok Verma, Ph.D., P.E.
Program Manager

Harding Lawson Associates
7655 Redwood Boulevard
P.O. Box 578
Novato, California 94948
415/892-0821

Under Contract to:

PRC Environmental Management, Inc.
120 Howard Street, Suite 700
San Francisco, California 94105

January 2, 1992

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

LIST OF TABLES

1.0 INTRODUCTION

This air sampling program was developed on behalf of the Department of the Navy (Navy) Western Division (WESTDIV), Naval Facilities Engineering Command by Harding Lawson Associates (HLA) and Aqua Terra Technologies (ATT) for the field investigation phase of the Remedial Investigations/Feasibility Studies (RI/FSs) being performed at the Naval Station, Treasure Island, Hunters Point Annex (HPA), San Francisco, California. The air sampling program was implemented in accordance with the *Work Plan Volume 2E, Air Sampling Plan, Remedial Investigation/Feasibility Study, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California,* submitted by HLA in July 1988 (*HLA, 1988*), and *Addendum to Work Plan Volume 2E, Air Sampling Plan* submitted in August 1990 (*HLA, 1990*).

The program was implemented by HLA under contract to PRC Environmental Management, Inc. (PRC) on behalf of the Navy, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract No. N62474-88-D-5086 Contract Task Order 57 (CTO 57). Activities described in this report are part of RI/FS activities at HPA.

This sampling report outlines the locations and analytical parameters for air samples that were collected. This report also discusses the sampling methodologies, the sample analytical results, quality control assessment of the samples, and a summary and discussion of the implemented plan. This program was intended to be a screening study; therefore it should not be considered to yield a definitive representation of ambient air levels throughout the HPA facility. The program was designed to evaluate the presence of elevated baseline levels at the facility and to provide data that can be used in combination with dispersion modeling for the Public Health and Environmental

Evaluations (PHEEs). The results can also be used in developing further recommendations for subsequent air sampling to further characterize conditions at the entire site.

2.0 BACKGROUND

HPA is located in southeastern San Francisco at the tip of a peninsula extending eastward into San Francisco Bay. It has operated as a shipyard or ship repair facility almost continuously since 1869. Private industry owned or leased the property until 1941 when the Navy took possession. The Navy operated the shipyard until 1974, and in 1976, leased it to Triple A Machine Shop (Triple A). Triple A operated the ship repair facility and also leased numerous buildings to other private commercial and light industrial firms. Historically, operation of the facility involved the use of hazardous materials and the subsequent generation of a wide variety of solid and liquid wastes. In most cases, hazardous materials were disposed onsite following practices acceptable at the time.

Remedial Investigations (RI) are currently being conducted at 16 sites within HPA as part of the Navy's Installation Restoration (IR) program. These sites are designated as "IR" sites as shown on the sampling location map (Plate 1). IR sites are currently grouped into five Operable Units (OUs) as follows:

Operable Unit	IR Site	
OU I	IR-1/21	Industrial Landfill and Triple A Sites 1 and 16
	IR-2	Bay Fill Area and Triple A Sites 2, 13, 14, 17, 18 and 19; excluding IR-3
	IR-3	Oil Reclamation Ponds and part of Triple A Site 17
OU II	IR-6	Tank Farm
	IR-8	Building 503 PCB Spill Area
	IR-9	Pickling and Plate Yard
	IR-10	Battery and Electroplating Shop (Building 123)
OU III	IR-4	Scrap Yard and Triple A Site 3, north of Spear Avenue
	IR-5	Old Transformer Storage Yard
OU IV	IR-7	Sub-Base Area

OU V

Group 5

IR-11 Building 521, Power Plant
IR-12 Disposal Trench; Triple A Sites 3 (partial) and 4 (previously Site PA-12)
IR-13 Old Commissary Site, Triple A Sites 5 and 15 (previously Site PA-13)
IR-14 Oily Liquid Waste Disposal Site, Triple A Sites 6 and 7 (previously Site PA-14)
IR-15 Oil Waste Ponds and Incineration Tank, Triple A Sites 12 and 13 (partial; previously Site PA-15)
IR-17 Drum Storage and Disposal Site, Triple A Sites 10 and 11 (previously Site PA-17)

Group 6

IR-20 Building 156
IR-22 Buildings 368 and 369

Operable Unit V also contains Preliminary Assessment (PA) Sites that PA-16 and PA-18 and 37 PA sites are proposed for investigation in the Site Inspection (SI) program (not shown on Plate 1).

2.1 Summary of Previous Investigations

Site investigation activities at HPA initiated by the U.S. Navy in 1984 included the Initial Assessment Study (IAS), which identified 12 areas at HPA where hazardous wastes were historically disposed or spilled. Subsequent investigations performed during the Verification Step of the Navy Assessment and Control of Installation Pollutants program included the collection of soil and groundwater samples. The findings of this investigation were presented in a report entitled *Confirmation Study, Verification Step (EMCON, 1987a)*. Chemicals detected at varying concentrations in the samples collected included volatile organic compounds (VOCs), semivolatile organic compounds (SOCs), PCBs, heavy metals, and asbestos. Based on these studies, the Navy, in discussions with state and federal regulatory agencies, established 11 IR sites for further characterization. The air sampling plan (*HLA, 1988*) used as the basis for air sampling activities

documented in this report was based on these 11 IR sites; the plan was amended in 1990 (*HLA, 1990*), and retained the 11 IR sites as the plan basis.

2.2 Summary of Chemical Conditions

The results of previous investigations throughout HPA indicate that inorganic and organic chemicals are present in the subsurface at varying concentrations at many locations. Samples from the three OU I sites, Industrial Landfill (IR-1), Bay Fill Area (IR-2), and Oil Reclamation Ponds (IR-3), generally have the highest concentrations and largest number of detected chemicals relative to samples from other sites. Potential hazards identified in the Area Study (*EMCON, 1987b*) included asbestos-containing materials (ACM).

The chemicals detected in soil and groundwater include VOCs, SOCs, PCBs, oil and grease (O&G), heavy metals, and asbestos. Soil appears to be affected to a greater degree than groundwater. Low levels of beta and gamma radioactivity have been reported at the landfill. However, preliminary results of recently completed high volume air sampling do not show levels of concern (*Department of the Navy, 1991*).

2.3 Existing Air Sampling Data

Site-specific data on meteorological conditions and air quality at HPA are limited. Meteorological data were collected October 7-14, 1988, as part of Solid Waste Air Quality Assessment Test (SWAQAT) activities (*HLA, 1989*). Long-term meteorological data are available from the San Francisco Airport (SFO) and were summarized and used for interpreting chemical concentration data from this study.

Three air sampling projects have been conducted to assess the effects of contaminated soil or groundwater on the quality of the air at HPA. These studies

include the collection and analysis of air samples for 1) airborne asbestos near the Building 521 Power Plant (IR-11); 2) metals in the Battery and Electroplating Shop (IR-10); and 3) airborne asbestos, metals, and organic compounds at proposed Housing Sites 1 and 2.

2.3.1 Airborne Asbestos at Building 521 Power Plant (IR-11)

Two ambient air samples were collected at a location downwind of the Building 521 Power Plant (*EMCON, 1987a*). During the IAS, 400 to 500 pounds of discarded waste asbestos were found on the ground immediately outside the building. In addition, the insulation on some of the boilers and other equipment had deteriorated and was in a friable condition. Some asbestos was reported to have been washed by rainwater into the surrounding unpaved area. Each air sample, collected over an 8-hour duration, was analyzed for asbestos fibers by transmission electron microscopy (TEM). No asbestos was detected in either sample.

2.3.2 Airborne Metals at Battery and Electroplating Shop (IR-10)

During the collection of floor scraping samples inside Building 123, the Battery and Electroplating Shop, a 3-hour air sample was collected by attaching a personal sampling pump and filter cassette to a field technician (*EMCON, 1987a*). The concentrations (in micrograms per cubic meter) of detected airborne metals are indicated in the list below:

Metal	Concentration ($\mu g/m^3$)
Cadmium	1.3
Chromium	4.6
Lead	16.0
Zinc	4.4

2.3.3 Airborne Metals, Asbestos, and Organics at Proposed Housing Sites

In 1987, a risk assessment (*ATT, 1987*) was conducted for two proposed housing areas (Areas 1 and 2) near the main gate. As part of this study, ambient air samples were collected and analyzed for metals, asbestos, and organic compounds (including PCBs, VOCs, and SOCs) at a number of locations on four sites:

- An area in HPA north of Crisp Avenue, directly north of the Industrial Landfill (IR-1)
- An area in HPA southeast of Donahue Street near the main gate
- The Industrial Landfill (IR-1)
- An upwind background site.

VOC samples were collected over an 8-hour period and analyzed by EPA Method 624. SOC samples were collected over an 8-hour period using XAD-2 sorbent tubes and analyzed by EPA Method 625. Metals samples were collected over an 8-hour period using mixed cellulose ester filters and analyzed using inductively- coupled argon plasma emission instrumentation or graphite furnace atomic absorption. Asbestos was collected over an 8-hour period using mixed cellulose ester filters and analyzed by transmission electron microscopy.

Results of the air sampling, which are summarized in Table 1, indicated that several different VOCs and SOCs were detected at all four sampling locations. Metals were detected at two of the sampling locations. Asbestos was detected at only one sampling location.

3.0 OBJECTIVES

The objectives of the sampling plan (*HLA, 1988, 1990*) were to:

- Perform a screening-level sampling at selected locations to assess the presence of air contaminants that might result from chemicals found in the soil and groundwater.
- Assess the need for further air sampling and define the scope and focus of such sampling.
- Obtain baseline air quality data for the Public Health and Environmental Evaluations (PHEEs).

This program was intended to be a screening study; therefore it should not be considered as a definitive representation of actual ambient air levels throughout the HPA facility. Since this was a screening-level sampling, an attempt was made to collect air samples at locations likely to have the highest concentration of contaminants. As a result, air sampling locations were selected at or near (and downwind of) possibly contaminated areas, rather than at widely separated potential human receptors. In addition to sampling the air at or near known contaminated areas, samples were collected under meteorological conditions that would maximize emissions and entrainment (i.e., elevated temperatures, dry conditions and high winds, characteristic summer conditions for this area). Also, wind conditions are uniform and persistent at this time of year, blowing from the west/northwest. This allows for accurate placement of the monitors downwind of the individual sources, and increases the likelihood that samples reflect air quality near and downwind of IR sites.

Recommendations are made in Section 7.0 of this report for additional air sampling to further evaluate air quality at HPA.

4.0 TECHNICAL APPROACH

The air sampling program was implemented in accordance with the *Work Plan Volume 2E, Air Sampling Plan, Remedial Investigation/Feasibility Study, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California*, submitted by HLA in July 1988 (*HLA, 1988*), and *Addendum to Work Plan Volume 2E, Air Sampling Plan* submitted in August 1990 (*HLA, 1990*).

4.1 Overview of Program

The data collected during this air sampling program, where applicable, will be used in the PHEEs. As previously stated, the data from, at, or near the potential contaminated areas will be compared with modeled levels to assess potential exposures at the human receptor locations. However, based on wind rose data for the area, the human receptor locations are not generally downwind of the HPA sites. In addition, air samples were collected during the month of July, when meteorological conditions are believed to be conducive to producing maximum concentrations of airborne contaminants originating from soils and/or groundwater at HPA.

4.2 Rationale for Selecting Sampling Locations

Sampling locations were identified on a preliminary basis using meteorological data collected at SFO and as part of the SWAQAT (*HLA, 1989*). Specific locations of samplers were selected on the day of sampling depending on observed prevailing wind conditions. These locations are shown on Plate 1. Sampling stations were placed either directly over or adjacent to and downwind of current IR sites. A sampling station was also placed on the downwind perimeter of HPA to intercept airborne contaminants that might originate from other sources at the site. Two sampling stations were placed upwind of HPA to characterize background concentrations. With the exception of

Location 9 (Plate 1), samplers were not placed downwind of interfering sources, such as painting operations, gasoline pumps, or any industrial emission source not related to the IR sites. At Location 9, tenants on or directly adjacent to the IR-9 site are suspected of releasing a variety of airborne contaminants.

Locating the samplers at or near the IR sites and timing the sampling to coincide with meteorological conditions conducive to generating maximum concentrations for the analytes of interest was intended to maximize the potential for detecting airborne contaminants originating from the subsurface at HPA; the concentrations of analytes detected should be a conservative estimate of potential exposures to receptors.

4.3 Rationale for Selecting the Number of Sampling Locations

The sampling effort was intended as a screening approach to assess potential worst-case exposure levels from certain sources at the site. The number of samples selected was related to the number of contaminated sites that were present when the plan was initially developed. Samplers were located at or downwind of such sites. Locations 3 and 5 when initially selected were located outside the perimeters of IR-2 and IR-5, respectively. Because of IR boundary adjustments subsequent to the air sampling tasks, these two sampling locations are now located within the perimeters of the IRs. Sampler location identification numbers and corresponding area of study are listed below. IR sites added to the RI program after the approval of the air sampling plan, but addressed by the approved locations, are also included in this list.

Location Number	Description
01	Within IR-1/21
02	Downwind of IR-2 and IR-13
03	Within IR-2 and downwind of IR-3, IR-11, IR-14, and IR-15
04	Downwind of IR-4 and IR-1/21
05	Within IR-5 and downwind of IR-4, IR-5, IR-12, and IR-1/21
06	Downwind of IR-7
07	Downwind of IR-6 and IR-10
08	Downwind perimeter sampler
09	Downwind of IR-9
10	Downwind perimeter sampler within IR-22
11, 12	Upwind background locations

Location 11 was selected as an upwind perimeter sample based on the original sampling plan. Although it is not located within an IR boundary, the area on which the sampler was located is suspected of containing contaminants similar to those found at current IRs 1/21.

4.4 Analytical Program

4.4.1 Rationale for Analytes Selected

HPA has a long history of industrial operations, during which a wide variety of chemicals were used, stored, and disposed. Because of this broad spectrum of potential chemical contaminants, a comprehensive screening is required. Four samples were taken from each air sampling station over a five day period and were analyzed for VOCs, SOCs (including PCBs), metals, asbestos and formaldehyde. Formaldehyde was added to the list to be measured in the Addendum to Work Plan (*HLA, 1990*) in response to comments made by Mr. John N. Richards of Versar, Inc. on April 16, 1990.

4.4.2 Analytical Methodologies

Table 2 summarizes the analytical methodologies that were used for the analysis

of airborne VOCs, SOCs, metals, asbestos, and formaldehyde samples. The QA/QC program is described in Section 6.0.

4.4.2.1 Volatile Organic Compounds

A combination of modified EPA Compendium Methods TO-1 and TO-2 using EPA volatile organic sampling tubes (VOST) in series, was selected because of their capability of detecting all 38 VOC target analytes listed in the air sampling plan (*HLA, 1988*). The contaminants were removed from the adsorbent using thermal desorption and were analyzed by gas chromatography/mass spectroscopy (GC/MS). The target VOC compounds are listed in Table 3.

4.4.2.2 Semivolatile Organic Compounds

EPA Methods TO-4 and TO-13 were selected in the original air sampling plan (*HLA, 1988*) for the collection and analysis of SOCs. A review of EPA Methods TO-4 and TO-13 indicated that only 40 of the 81 SOC target analytes listed in the original sampling plan were detected by these two standard methods. Discussions with Enseco Analytical Laboratories of Sacramento, California, indicated that a combination polyurethane foam (PUF) XAD-2 resin cartridge would be the most efficient combination for collecting and analyzing SOCs. Discussions indicated that the method that was finally selected, a modified EPA Method 8270, was capable of detecting all 81 SOC target analytes listed in the sampling plan, at the required levels of detection.

The XAD resin cartridges were extracted using SW-846 Method 3450, soxhlet, and analyzed for the semivolatile constituents using Method 8270, GC/MS. The PUFs were extracted and analyzed using Method TO-4.

The extracting solvent was a 1:1 dichloromethane (DCM) / acetone mixture rather than a 5 percent diethyl-ether/hexane mixture which was mentioned in the 1988

sampling plan. The DCM/acetone mixture is an improvement over the previous mixture since it is easier to handle.

The target compounds are listed in Table 4.

4.4.2.3 Metals

Airborne particulate matter was collected on a glass-fiber filter using a high-volume sampler. The filter was analyzed for the compounds listed in Table 5 using inductively coupled argon plasma (ICAP). The methodology was developed by EPA's Environmental Monitoring Systems Laboratory (*EPA, 1983*).

4.4.2.4 Asbestos

Sampling for asbestos was performed according to procedures outlined in NIOSH Method 7400 (*NIOSH, 1984*) and analyzed by Yamate Level II TEM. Samples were collected on a mixed cellulose ester filter and examined by TEM.

4.4.2.5 Formaldehyde

The method selected for the sampling and analysis of formaldehyde was U.S. EPA Compendium Method TO-11. TO-11 employs prepackaged cartridges of silica gel coated with acidified 2,4-dinitrophenylhydrazine (DNPH). The analysis was conducted using high performance liquid chromatography.

4.5 Field Methods and Procedures

This section outlines procedures for the collection of airborne VOCs, SOCs, metals, asbestos and formaldehyde. It includes details regarding the selection of sampling volumes, sampling duration, flow rates, and cartridge configuration. The

following general procedures applied to the collection of all sample types.

- A meteorological review was performed prior to the sampling to characterize the meteorology at HPA and to aid in the refinement of sampling locations.

- Prior to the sampling, a site reconnaissance was performed to select sampling locations. Careful attention was paid to prevailing wind conditions, proximity to obstructions, interfering sources, and security.

- Both high-volume and personal samplers were calibrated immediately onsite or at the HLA warehouse according to manufacturer and EPA-approved procedures.

- The following procedures were followed in the final selection of sampling sites:

  - Samplers were placed downwind of the selected sites, based on prevailing wind conditions, except those samplers selected for upwind locations.

  - Attempts were made to locate samplers away from obstructions and to place them at distances of at least twice the heights of the obstructions.

  - Samplers were placed away from the influence of any interfering sources (e.g., industrial operations).

  - Samplers were placed in a secure location.

- The following quality control samples were collected (see Section 6.0):

  - One collocated (replicated) sample was collected for each group of analytes (e.g., VOCs). Samples were collected at the site with the highest probability of producing airborne contamination.

  - Field blank samples were submitted at a frequency of one per group of analytes.

  - One batch of blank samples was submitted for each batch or lot of sampling media prepared.

Each sampler was assigned a location number. A fictitious Location #13 was assigned to sample blanks. Any deviations from the sampling plan were documented in the field log sheets.

4.5.1 Site Reconnaissance

4.5.1.1 Meteorological Monitoring

Prior to selecting specific air sampling stations, the existing historical meteorological data were evaluated. The two sources of meteorological data were the SFO and onsite meteorological stations. SFO is approximately 7 miles south of HPA; its position with respect to nearby bodies of water, land, and mountains is similar to that of HPA. To assess actual conditions prior to sampling, two meteorological stations were placed onsite, near IR-1 and IR-7 (see Plate 1), to continuously monitor wind speed and direction. Data were gathered over a period of 2 weeks. Twenty-four-hour meteorological data were also collected concurrently with the air sampling. Due to a malfunction of the digital data storage equipment, meteorological data were not permanently recorded for the onsite meteorological stations. Meteorological data for SFO for June 24 through July 12, 1991, were obtained from the U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service in Redwood City, California.

4.5.1.2 Selection of Sampling Station Locations

After windflow patterns at HPA were reviewed, specific sampling locations were selected, according to the criteria outlined in Section 4.5. Meteorological data obtained on the day of sampling were evaluated to aid in the selection of sampling sites that would be downwind of sites in question.

4.5.2 Sampling Procedures

All samples were collected in accordance with the plan, except where specifically noted in this report, and subsequently submitted to the appropriate analytical laboratory under required chain of custody procedures.

4.5.2.1 VOCs

One sampling unit was used for each sampling location. The sampling unit employed two VOST tubes (a primary and a backup) containing CMS adsorbent and Tenax GC. A precalibrated personal pump with built-in rotameter and preset flow rates was affixed to a metal stake such that the inlet was 3 to 6 feet (breathing zone) above ground level. Using clean latex gloves, the technician attached the appropriate cartridge to the pump via Teflon tubing. The pump was then started and the following information was recorded on the sampling data sheet: location, sampler identification, analyses to be performed, time, rotameter reading, and flow rate. The sampler was allowed to operate for 20 minutes at a flow rate of 0.5 liters per minute in accordance with the sampling method. The flow rate was checked at least once, about midway through the sampling, and the above parameters were again recorded. At the end of the sampling period, the above parameters were recorded and the unit was turned off. Using clean latex gloves, the technician removed the cartridge from the sampling unit and placed it in the appropriate culture tube. A sample label was affixed to the culture tube, which was then placed upright in a cooler containing blue ice and protected from light.

4.5.2.2 SOCs

A General Metal Works model PS-1 high-volume sampling unit was used with a combination PUF/XAD-2 resin cartridge for the sampling of SOCs. A precalibrated unit with preset flow rates of 280 liters per minute was placed at the sampling location, with the inlet 3 to 6 feet above ground. Samples were collected for a duration of 8 hours. The exhaust hose was directed downwind of the samplers and placed in such a manner so as not to stir dust. A gasoline-driven generator was used as the electric power source, and was placed at least 50 feet downwind of the samplers. All sample

contact areas were rinsed with pesticide-grade hexane. Using clean latex gloves, the technician loaded a pre-assembled cartridge. The cartridge contained XAD-2 resin sandwiched between two PUF plugs. The module was then assembled into the sampler and the motor started. The following notations were recorded in the field logbook: location, sampler number, analyses to be performed, time, magnehelic reading, and flow rate. The sampling unit was inspected periodically and the above parameters were again recorded. At the end of the sampling period, the above information was recorded for the final time and the power was turned off. The technician removed the cartridge using clean latex gloves. The cartridge was then wrapped with aluminum foil and placed in the original glass sample container. A sample label was affixed to the container, which was then placed upright in a cooler containing blue ice and protected from light.

Magnehelic readings were converted to flow rates using a calibration curve.

4.5.2.3 Metals

Metals in ambient air were sampled using a high-volume sampler, approximately 3 feet above the ground. Procedures discussed for SOC sampling (including flow rates) were the same for the metals sampling with the exception that glass fiber filters were used in place of the XAD-2 and PUF sampling media. At the end of sampling, the glass fiber filter was folded in half (sample side inward), and placed inside a zip-lock bag and properly labeled.

4.5.2.4 Asbestos

Battery-operated SKC personal sampling pumps in conjunction with a mixed cellulose ester membrane filter housed in a conductive 25-mm cassette were selected for asbestos sampling. Sample cassettes were affixed to a metal sampling stand placed on the ground and collected at an elevation of approximately 5 feet above ground level.

The cassette was attached to the pump inlet via tygon tubing. Pumps were calibrated at 2.0-3.0 liters per minute prior to the initiation of sampling and flow rate adjustments were made. The following parameters were recorded on the data sheet and placed in the field log book: location number, sample number, analyses to be performed, time, rotameter reading, and flow rate. Periodic checks were made and the above data were again recorded. At the end of the 8-hour sampling period, final readings were made and the pump was turned off. Cassettes were capped, removed from the sampling assembly, placed in labeled zip-lock bags, and stored upright.

4.5.2.5 Formaldehyde

Formaldehyde in air was sampled over an 8-hour period by a glass cartridge containing Florisil impregnated with DNPH. Sample cartridges were affixed to a metal sampling stand placed on the ground and collected at an elevation of approximately 5 feet above ground level. The cartridge was attached to a SKC personal sampling pump via tygon tubing. Pumps were calibrated prior to the initiation of sampling and flow rate adjustments were made after placing the sampling cartridge in the sampling train. The samples were collected at approximately 4.0 liters per minute. The following parameters were recorded on the data sheets: location number, sample number, analysis to be performed, time rotameter reading, and flow rate. Periodic checks were made and the above data were again recorded. At the end of the sampling period, final readings were made and the pump was turned off. The cartridges were removed from the sampling assembly, capped at both ends, labeled, placed in zip-lock bags, and stored in a cooler with blue ice.

5.0 RESULTS

Validated analytical results by location for four types of target analytes (VOCs, SOCs, metals, and asbestos) are presented in Table 6 through 9, respectively. The results presented in these tables reflect only samples in which detectable concentrations of the target analytes were measured. Airborne concentrations are reported in micrograms per cubic meter and were calculated by dividing the mass of each individual chemical (as reported by the laboratory) by the corrected volume of air sampled. Formaldehyde does not appear in any of the tables because all formaldehyde air samples were rejected during the data validation process. Data qualifiers assigned during validation appear with the data and are defined at the end of the tables. Information on data validation is presented in Section 6.8.

5.1 Meteorological Data

During an average day of the period for which the SFO data were available (June 24 to July 12, 1991) the temperatures ranged from a minimum of 51° F to a maximum in the upper 60s at 2-4 p.m.; a peak of 90° was observed on July 1. Over this same time period, the winds usually began at about 10 knots and were generally out of the west-northwest. On warm days, such as July 1 and 2, the morning winds were approximately 5 knots and variable in direction. As the day progressed, the wind speed increased to a peak of 16-20 knots in the middle to late afternoon. Peak values of wind speed of 21 knots were observed on several days through the period. The wind direction remained consistently in a west to northwest range throughout most of the days.

Wind conditions were observed at the HPA meteorological stations twice a day during the sampling period; once at mid-morning and once at mid-afternoon. Wind speed and direction were observed visually and compared to the digital and analog

displays on the onsite meteorological stations, and to "real-time" SFO data obtained by telephone (415-363-7974) from the National Weather Service. Table 10 presents the results reported for SFO; Plate 1 shows a wind rose plot of these data. A comparison of the data indicated that there was strong agreement between the SFO and HPA conditions. These similarities are further supported by comparisons of SFO data and HPA SWAQAT meteorological data which were collected in 1989 (*HLA, 1989*). In both cases wind directions from the west and west-northwest prevailed.

5.2 Volatile Organic Compounds

Low concentrations (nanogram per cubic meter levels) of a number of VOCs were detected at all the sampling locations, except Location 5. The VOCs identified included acetone, benzene, 2-butanone, ethylbenzene, methylene chloride, toluene, 1,1,1-trichloroethane, tetrachlorethene, styrene, and xylenes. The VOCs identified at Location 9 may be attributable to the tenants of Building 411 (directly adjacent to IR-9) who are suspected of using hydrocarbon solvents in their operation. Use of hydrocarbon solvents was not observed at the specific times of the air sample collection.

5.3 Semivolatile Organic Compounds

Low concentrations of SOCs (nanogram per cubic meter levels) were detected at sampling locations 6, 7, 8, 11, and 12. No SOCs were detected at sampling locations 1, 2, 3, 4, 5, 9, and 10. The SOCs identified included aldrin, dieldrin, DDT, endrin, heptachlor, lindane, and naphthalene.

5.4 Metals

Low concentrations of metals (microgram per cubic meter levels) were detected at sampling locations 7, 8, 9, 10 and 11. The metals identified included barium,

chromium, copper, lead, mercury, and zinc.

5.5 Asbestos

Asbestos samples indicated the presence of some airborne asbestos in the form of chrysotile fibers. The majority of structures identified were nonasbestos gypsum. Asbestos concentrations ranged from 0.022 structures per cubic centimeter (s/cc) at Location 12 to nondetectable concentrations at other sample locations.

5.6 Formaldehyde

All the formaldehyde samples indicated nondetectable concentrations. However, as mentioned in Enseco laboratory correspondence, the characteristic yellow color of DNPH was not noted in the extractant solution for the formaldehyde analyses. Therefore, the cartridge media may not have been impregnated with DNPH. The presence of this compound was crucial for the adsorption of formaldehyde in the cartridge.

The formaldehyde data for these samples were qualified with an "R" (rejected); samples should be recollected during subsequent air sampling efforts.

5.7 Summary of Analyte Groups Detected by Location

The following table summarizes the air sampling results by location for each of the 4 analyte groups.

LOCATION NUMBER	Number of Compounds Detected by Group VOCs	SOCs	METALS	ASBESTOS
1	2#	0	0	Y *
2	2	0	0	N **
3	5	0	0	Y
4	6	0	0	N
5	0	0	0	N
6	5	1	0	Y
7	7	1	1	N
8	1	4	3	Y
9	10	0	5	N
10	4	0	4	N
11	7	6	4	Y
12	8	1	0	Y

* Y = Detectable concentrations of airborne asbestos
** N = No detectable concentrations of airborne asbestos
\# = Indicate number of different compounds detected for this group of analytes

6.0 QUALITY ASSURANCE/QUALITY CONTROL ASSESSMENT

6.1 Deviations from the Original Plan

In general, the air sampling was conducted in accordance with the quality control requirements with the following exceptions:

Two meteorological stations were established in areas IR-1 (digital) and IR-7 (analog), respectively. The digital data-logging capabilities of the IR-1 station malfunctioned rendering the collected data irretrievable. Subsequent attempts to digitize back-up analog strip chart data were unsuccessful. Daily selection of sample locations was based on daily visual observations, real-time data retrieved from the HPA meteorological stations and SFO National Weather Service data.

VOCs were sampled with glass volatile organic sampling tubes (VOST) and were analyzed according to modified EPA Test Methods TO-1 and TO-2. The use of sampling tubes produces similar results to evacuated stainless steel canisters originally proposed.

The XAD resin segments of the samples were extracted using SW-846 Method 3450, soxhlet, and analyzed for the semivolatile constituents using Method 8270, GC/MS. The PUFs were extracted and analyzed using Method TO-4. In the original plan a modified TO-4 and TO-13 method were to be used for PUF/XAD-2.

Composite air samples were not collected over a 24-hour period of time. Instead, shorter sampling periods were selected to facilitate exposure to periods when maximum potential concentrations of contaminants were expected.

The initial set of samples collected at Locations 8, 11, and 12 were rejected because field observations of wind direction indicated the sampling locations were not downwind of the corresponding sources. Therefore, several of the sample identification numbers are missing.

Two SOC samples were not collected for Location 10. Three SOC samples were not collected for Location 11. One metals sample was not collected for Location 11. One metals sample was not collected for Location 12. Sample shortages were the result of changing sample locations and the lack of sufficient additional sampling media within the scheduled sampling period.

6.2 Validation of Analytical Results

The results for laboratory and field quality control (QC) samples were reviewed for compliance with project quality assurance goals. Quality control criteria and samples reviewed included holding times, laboratory method blanks, laboratory control samples (LCS), duplicate control samples (DCS), and trip blanks.

Samples that exceeded their holding times were qualified with a J5, estimated, due to holding time exceedance. This occurred for a number of samples analyzed for formaldehyde, pesticides, PCBs, and PAHs.

All "percent recovery" values for LCS and DCS QC samples and calculated relative percent difference values were within the control limits stated in the Enseco laboratory reports.

All laboratory method blanks associated with the samples had no detected chemicals of concern. Results were sent by Enseco under separate cover and confirmed by HLA.

Sample No. 149, listed as a "trip blank" on the chain of custody form, contained the following metals on the filter:

Metals	Concentration (mg)	5x Value (mg)
barium	0.0038	0.019
chromium	0.0077	0.0385
copper	0.0050	0.025
lead	0.013	0.065
zinc	0.0087	0.0435

The "5x Value" represents the criterion evaluating the significance of blank contamination. (*EPA, 1988 and 1988a*). If associated sample results are less than 5x the value found in the blank, the sample value is qualified with a "U", nondetected, in the sample result tables.

As mentioned in the Enseco cover letter, a characteristic yellow color of DNPH was not noted in the extractant solution for the formaldehyde analyses. Therefore, the cartridge media may not have been impregnated with DNPH. The presence of this compound is crucial for the adsorption of formaldehyde in the cartridge. Because of this discrepancy, the formaldehyde data for these samples were qualified with an "R", rejected, and are unusable.

7.0 SUMMARY AND RECOMMENDATIONS

Comparison of meteorological data between the HPA site and the SFO site indicates a strong similarity between the two sites.

Results of this screening air sampling program indicate that receptors downwind of the sampling stations may be subjected to extremely low concentrations of the four types of target analytes (VOCs, SOC, metals, and asbestos) in this study. Locations 8 and 11 had measurable levels in all four target contaminant groups.

These baseline air sampling data may be used in support of the PHEEs, but should not be considered definitive or exhaustive in their representation of HPA site conditions. The data represent the concentrations of airborne contaminants at sample locations, for a specific set of site conditions. Since most of the monitors were placed at locations immediately downwind of specific sources, the measured levels are likely to be greater than levels that would be representative of chronic exposure, because wind variability would reduce the concentrations measured over longer time periods.

Although the network of monitors may not be sufficient to detect the maximum levels bordering each OU, the combination of monitors downwind of the individual IR sites, along with backup perimeter stations (locations 8 and 10), give reasonable assurance that high chemical concentrations at the site perimeter are not expected to occur. The actual maxima downwind of specific sites can be determined by conducting dispersion modeling of the emissions. The data contained in this report can be compared with modeled levels for specific monitor locations to verify the accuracy of the model results. Thus, dispersion modeling in combination with the monitor data can be used to evaluate exposure levels from, for example, OU II sources. These monitor data should also be compared with measured analytes in soil and groundwater to verify source - receptor relationships.

To evaluate maximum air concentrations bordering each IR site, additional air monitoring would be required. Suggestions for additional monitoring are discussed below:

- The monitors placed downwind of the larger IR sites such as 1, 21, 2, 4, and 12 may not capture the maximum levels bordering each site if the air emissions originate from smaller pockets within the sites. If these pockets are not directly upwind of specific IR monitors, the monitors may miss the emission plume. Measured levels would only be detected in lower concentrations at other monitors farther downwind of the site perimeter. These larger sites can be more accurately characterized by first identifying potential pockets of air emissions based on soil sampling data, and then conducting flux chamber measurements directly over the individual pockets or conducting ambient air measurements directly downwind of one or more pockets (*EPA, 1989*).

- The air sampling network may not have detected maximum levels emitted from Sites IR-8, IR-10, and IR-22. Relocation of monitors to areas that are closer to these sites and that are directly downwind of the potential air emissions would increase the likelihood of measuring maximum levels.

- If it is suspected that formaldehyde emissions might occur at some sites, additional measurements of this substance may be required at certain locations. The amount of additional formaldehyde monitoring can best be assessed by identifying potential sources of formaldehyde, based on soil gas measurements, and then placing formaldehyde measuring systems downwind of the suspected sources.

- The 8-hour time period for operating the monitors should be extended to collect more sample material. These devices are not continuous monitors, but instead are sample integrators over time that are subsequently analyzed at the laboratory. Therefore, longer operating times or multiples of operations would allow for more samples to be collected and analyzed, thus reducing experimental measurement errors. The number of additional measurements that should be carried out over extended time periods can be determined by examining the screening results and identifying those measurements that produced levels below the method detection limits. If these minimum detection limits correlate to air concentrations that are considered unhealthful, then measurements should be repeated for an extended period.

- Finally, asbestos measurements should be repeated using the new EPA method at certain locations (*EPA, 1990*). The number and locations of these measurements can be determined by identifying suspected sources of asbestos at the site based on an inventory of the materials. In all cases the new measurements would include 24 hours of sample collection to ensure sufficient material for detection.

8.0 REFERENCES

Aqua Terra Technologies (ATT), Inc., 1987. *Draft Risk Assessment, Proposed Housing Areas 1 and 2, Naval Station, Treasure Island, Hunters Point Annex.* December. Contract Number N62474-86-D-0996. December.

_____, 1988. *Public Health and Environmental Evaluation (PHEE) Plan, RI/FS, Hunters Point Annex, San Francisco, California (draft).* June.

_____, 1989. *Report of Air Monitoring Data Collected at Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California.* September 1987, May.

Department of the Navy, 1991. *Memorandum from Commander Western Division re Technical Review Committee Meeting, September 25, 1991.* October 10.

EMCON Associates, 1987a. *Confirmation Study, Verification Step, Hunters Point Naval Shipyard (Disestablished), San Francisco, California* (4 volumes). March 19. Contract N62474-85-C5501.

_____, 1987b. *Area Study for Asbestos-Containing Material and Organic and Inorganic Soil Contamination, Hunters Point Naval Shipyard (Disestablished), San Francisco, California* (2 volumes). July 2. Project 365-02.03.

EPA - see U.S. Environmental Protection Agency

Harding Lawson Associates (HLA), 1988. *Work Plan Volume 2E, Air Sampling Plan, Remedial Investigation/Feasibility Study, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California.* July.

_____, 1989. *Solid Waste Air Quality Assessment Test, Naval Station, Treasure Island, Hunters Point Annex, San Francisco, California.* March.

_____, 1990. *Addendum to Work Plan Volume 2E, Air Sampling Plan, Naval Station Treasure Island, Hunters Point Annex.* August.

National Institute for Occupational Safety and Health, Division of Physical Sciences and Engineering, (NIOSH), 1984. *NIOSH Manual of Analytical Methods.* Third Edition, Volume 1. Cincinnati, Ohio.

U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, 1983. *Standard Operating Procedures for the ICP-DES Determination of Trace Elements in Suspected Particulate Matter Collected on Glass-Fiber Filters,* Prepublication copy. October 1983.

U.S. Environmental Protection Agency, 1987. 40CFR Part 763, Asbestos-Containing Materials in Schools; Final Rule and Notice, October.

U.S. Environmental Protection Agency, 1988a. Functional Guidelines for Evaluating Organics Analyses, February.

U.S. Environmental Protection Agency, 1988b. Functional Guidelines for Evaluating Inorganics Analyses, July.

U.S. Environmental Protection Agency, 1988. Estimation of Baseline Air Emissions at Superfund Sites, MTIS No. BB89-180053, January.

U.S. Environmental Protection Agency, 1990. Environmental Asbestos Manual. Superfund Method for Determination of Asbestos in Ambient Air. EPA/540/2-90/005b, May.

TABLES

Table 1. Summary of Previous Air Sampling Analytical Results for Areas 1 and 2

Chemical	Number of Locations	Samples Collected	Number Samples with Detected Levels	Range of Concentrations (mg/m^3)* Minimum	Maximum
acetone	3	3	1	1.1×10^{-3}	1.1×10^{-3}
2-butanone	2	3	1	4.23×10^{-4}	4.23×10^{-4}
trichloro-fluoromethane	2	3	1	7.37×10^{-5}	7.37×10^{-5}
dichloromethane	9	18	6	2.0×10^{-4}	3.07×10^{-4}
ethylbenzene	9	17	9	9.3×10^{-5}	2.8×10^{-4}
tetrachloroethene	9	17	9	5.9×10^{-5}	1.89×10^{-4}
toluene	9	17	17	2.2×10^{-4}	1.3×10^{-3}
1,1,1-trichloroethane	3	3	1	4.6×10^{-4}	4.6×10^{-4}
xylenes	9	16	8	2.9×10^{-4}	1.3×10^{-3}
SOCs					
diethylbenzene isomers	9	19	15	1.42×10^{-3}	1.1×10^{-2}
triethylbenzene	9	18	9	3.64×10^{-4}	7.5×10^{-4}
unidentified phthalate	9	19	10	3.6×10^{-4}	7.2×10^{-4}
Metals					
aluminum	9	18	1	1.01×10^{-2}	1.01×10^{-2}
iron	9	18	2	4.4×10^{-7}	4.4×10^{-4}
Asbestos	9	14	1	1.8×10^{-2} (f/cc)**	1.8×10^{-2}

Notes:

* milligrams per cubic meter of air

** fibers per cubic centimeter of air

Source: *ATT, 1987*

Table 2. Summary of Sampling and Analytical Methodologies

	Sampling				Analyses				
Analyte	Pump	Pumping Rate (lpm)[1]	Filter/ Adsorption Medium	Shipment	Method	Extraction Medium	Analytical Instrument	Detection Limits	Target Compounds
VOC	Low flow	0.4	CMS	On dry ice	TO-2	Thermal desorption	GC/MS[2]	0.07-0.10 ug/m^3	VOCs with boiling points less than 80°C (Table 3)
	Low flow	0.1	Tenax	On dry ice	TO-1	Thermal desorption	GC/MS	0.28-0.56 ug/m^3	VOCs with boiling points greater than 60°C (Table 3)
SOC	High-volume	250	Glass-fiber filter and XAD-2/PUF	On dry ice	--	5% diethylether in hexane	GC/MS	0.02-0.1 ug/m^3	SOC, Pesticides and PCBs (Table 4)
Metals	High-volume	1,500	Glass-fiber filter	--	EPA, 1983	Nitric and Perchloric Acids	ICAP[5]	.58-111 ng/m^3	Metals (Table 5)
Asbestos	Medium flow	2.0	MCEF[3]	--	NIOSH[4] 7402	N/A	TEM[6]	0.005 fiber/cc	Asbestos

NOTES:

1 Liters per minute

2 Gas Chromatograph/Mass Spectrometer

3 Mixed cellulose ester filter

4 National Institute of Occupational Safety and Health

5 Inductively Coupled Argon Plasma Emission Spectrometer

6 Transmission Electron Microscope

Table 3. Organic Compounds Identifiable by VOC Method

CAS* No.	Compound	Approximate Detection Limit ($\mu g/m^3$)
29479-9	chloromethane	0.14
29584-5	bromomethane	0.14
9003-22-9	vinyl chloride	0.14
29480-2	chloroethane	0.14
75-09-2	dichloromethane	0.07
67-64-1	acetone	0.56
75-10-0	carbon disulfide	0.28
75-69-4	trichlorofluoromethane	0.07
75-34-3	1,1-dichloroethane	0.07
75-35-4	1,1-dichloroethene	0.07
107-06-2	trans-1,2-dichloroethene	0.07
76-66-3	chloroform	0.07
107-06-2	1,2-dichloroethane	0.07
71-55-6	1,1,1-trichloroethane	0.28
56-23-5	carbon tetrachloride	0.28
78-93-3	2-butanone	0.56
108-05-4	vinyl acetate	0.56
75-27-4	bromodichloromethane	0.28
78-87-5	1,2-dichloropropane	0.28
542-75-6	trans-1,3-dichloropropene	0.28
79-01-6	trichloroethene	0.28
71-43-2	benzene	0.28
124-48-1	chlorodibromomethane	0.28
79-00-5	1,1,2-trichloroethane	0.28
542-75-6	cis-1,3-dichloropropene	0.28
110-75-8	2-chloroethylvinyl ether	0.56
75-25-2	bromoform	0.28
591-78-6	2-hexanone	0.56
108-10-1	4-methyl-2-pentanone	0.56
79-34-5	1,1,2,2-tetrachloroethane	0.28
127-18-4	tetrachloroethene	0.28
108-88-3	toluene	0.28
108-90-7	chlorobenzene	0.28
100-41-4	ethylbenzene	0.28
100-42-5	styrene	0.28
	total xylenes	0.28
541-73-1	1,3-dichlorobenzene	0.28
	1,2 & 1,4-dichlorobenzenes	0.28

* Chemical Abstract Service.

Table 4. Organic Compounds Identifiable by SOC Method

CAS* No.	Compound	Approximate Detection Limit ($\mu g/m^3$)
62-75-9	N-nitrosodimethylamine	0.02
108-95-2	phenol	0.02
111-44-4	bis(2-chloroethyl)ether	0.02
95-57-8	2-chlorophenol	0.02
541-73-1	1,3-dichlorobenzene	0.02
106-46-7	1,4-dichlorobenzene	0.02
95-50-1	1,2-dichlorobenzene	0.02
39638-329	bis(2-chloroisopropyl)ether	0.02
621-64-7	N-nitrosodi-n-propylamine	0.02
67-72-1	hexachloroethane	0.02
98-95-3	nitrobenzene	0.02
78-59-1	isophorone	0.02
88-75-5	2-nitrophenol	0.02
105-67-9	2,4-dimethylphenol	0.02
11-91-1	bis(2-chloroethoxy)methane	0.02
120-83-2	2,4-dichlorophenol	0.02
120-82-1	1,2,4-trichlorobenzene	0.02
91-20-3	naphthalene	0.02
87-68-3	hexachlorobutadiene	0.02
59-50-7	4-chloro-3-methylphenol	0.02
77-47-4	hexachlorocyclopentadiene	0.02
88-06-2	2,4,6-trichlorophenol	0.02
91-58-7	2-chloronaphthalene	0.02
131-11-3	dimethyl phthalate	0.02
606-20-2	2,6-dinitrotoluene	0.02
208-96-8	acenaphthylene	0.02
83-32-9	acenaphthene	0.02
51-28-5	2,4-dinitrophenol	0.1
100-02-7	4-nitrophenol	0.1
121-14-2	2,4-dinitrotoluene	0.02
84-66-2	diethyl phthalate	0.02
7005-73-3	4-chlorophenyl-phenylether	0.02
86-73-7	fluorene	0.02
534-52-1	2-methyl-4,6-dinitrophenol	0.02
86-30-6	N-nitrosodiphenylamine	0.02
101-55-3	4-bromophenyl-phenylether	0.1

* Chemical Abstract Service.

Table 4. Organic Compounds Identifiable by SOC Method (continued)

CAS* No.	Compound	Approximate Detection Limit ($\mu g/m^3$)
118-74-1	hexachlorobenzene	0.02
319-85-7	beta-BHC	0.02
87-86-5	pentachlorophenol	0.1
85-01-8	phenanthrene	0.02
120-12-7	anthracene	0.02
87-86-5	pentachlorophenol	0.02
85-01-8	phenanthrene	0.02
120-12-7	anthracene	0.02
319-86-8	delta-BHC	0.02
76-44-8	heptachlor	0.02
84-74-2	di-n-butyl phthalate	0.02
309-00-2	aldrin	0.02
1024-57-3	heptachlor epoxide	0.02
206-44-0	fluoranthene	0.02
129-00-0	pyrene	0.02
959-98-8	endosulfan I	0.02
75-55-9	4,4'DDE	0.02
92-87-5	benzidine	0.1
60-57-1	dieldrin	0.02
72-20-8	endrin	0.02
72-54-8	4,4'DDD	0.02
33213-65-9	endosulfan II	0.02
7421-93-4	endrin aldehyde	0.02
85-68-7	benzyl-butylphthalate	0.02
50-29-3	4,4'DDT	0.02
1031-07-8	endosulfan sulfate	0.02
117-81-7	bis(2-ethylhexyl)phthalate	0.02
56-55-3	benzo(a)anthracene	0.02
218-01-9	chrysene	0.02
91-94-1	3,3-dichlorobenzidine	0.04
117-84-0	di-n-octylphthalate	0.02
205-99-2	benzo(b)fluoroanthene	0.02
207-08-9	benzo(k)fluoranthene	0.02
50-32-8	benzo(a)pyrene	0.02
193-39-5	indeno(1,2,3-cd)pyrene	0.02

* Chemical Abstract Service.

Table 4. Organic Compounds Identifiable by SOC Method (continued)

CAS* No.	Compound	Approximate Detection Limit ($\mu g/m^3$)
53-70-3	dibenzo(a,h)anthracene	0.02
191-24-2	benzo(ghi)perylene	0.02
57-74-9	chlordane	0.1
8001-35-2	toxaphene	0.1
12674-11-2	PCB-1016	0.1
11104-28-2	PCB-1221	0.1
11141-16-5	PCB-1232	0.1
53469-21-9	PCB-1242	0.1
12672-29-6	PCB-1248	0.1
11097-69-1	PCB-1254	0.1
11096-82-5	PCB-1260	0.1

* Chemical Abstract Service.

Table 5. Metals Identifiable by EPA Methods 6010/7000 Series

Metal	Analytical Method	Approximate Detection Limit (mg/m^3)
Silver (Ag)	6010	0.015**
Arsenic (As)	7060	0.007*
Barium (Ba)	6010	0.014**
Beryllium (Be)	6010	0.003**
Cadmium (Cd)	6010	0.008**
Cobalt (Co)	6010	0.015**
Chromium (Cr)	6010	0.015**
Copper (Cu)	6010	0.030**
Mercury (Hg)	7471	0.0006*
Molybdenum (Mo)	6010	0.030**
Nickel (Ni)	6010	0.060**
Lead (Pb)	7421	0.008*
Antimony (Sb)	6010	0.090**
Selenium (Se)	7740	0.008*
Thallium (Tl)	7841	0.008*
Vanadium (V)	6010	0.015**
Zinc (Zn)	6010	0.030**

* Based on analysis by atomic absorption.

** Based on analysis by inductively coupled argon plasma.

TABLE 6. SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN AIR SAMPLES

Location Number:	1				2				3				4			
Sample Number:	016				019				055				027			
Matrix:	AIR				AIR				AIR				AIR			
Sample Date:	07/08/91				07/08/91				07/10/91				07/09/91			
Lab Sample Number:	A9119310-008A/B				A9119310-011A/B				A9119310-012A/B				A9119310-004A/B			
Analyte Name	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.
Acetone	19	10	1.41E-04		23	10	1.71E-04		64	10	4.75E-04		25	10	1.86E-04	
Methylene Chloride	18	10	1.34E-04		20	10	1.49E-04		17	10	1.26E-03		17	10	1.26E-04	
2-Butanone	ND	10			ND	10			ND	10			ND	10		
1,1,1-Trichloroethane	ND	10			ND	10			ND	10			14	10	1.04E-04	
Benzene	ND	10			ND	10			67	10	4.98E-04		10	10	7.43E-05	
Toluene	ND	10			ND	10			19	10	1.41E-04		16	10	1.19E-04	
Tetrachloroethene	ND	10			ND	10			ND	10			ND	10		
Ethylbenzene	ND	10			ND	10			ND	10			ND	10		
Total Xylenes	ND	10			ND	10			32	10	2.38E-04		15	10	1.11E-04	
Styrene	ND	10			ND	10			ND	10			ND	10		

Location Number:	6				7				8				8			
Sample Number:	040				081				065				134			
Matrix:	AIR				AIR				AIR				AIR			
Sample Date:	07/10/91				07/11/91				07/10/91				07/15/91			
Lab Sample Number:	A9119310-007A/B				A9119310-009A/B				A9119310-009A/B				A9119705-001A/B			
Analyte Name	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.
Acetone	29	10	2.15E-04		70	10	5.20E-04		19	10	1.41E-04		18	10	1.34E-04	
Methylene Chloride	27	10	2.00E-04		200	10	1.48E-03		ND	10			ND	10		
2-Butanone	ND	10			ND	10			ND	10			ND	10		
1,1,1-Trichloroethane	ND	10			24	10	1.78E-04		ND	10			ND	10		
Benzene	24	10	1.78E-04		38	10	2.82E-04		ND	10			ND	10		
Toluene	25	10	1.86E-04		150	10	1.11E-03		ND	10			ND	10		
Tetrachloroethene	ND	10			ND	10			ND	10			ND	10		
Ethylbenzene	ND	10			41	10	3.04E-04		ND	10			ND	10		
Total Xylenes	23	10	1.71E-04		190	10	1.41E-03		ND	10			ND	10		
Styrene	ND	10			ND	10			ND	10			ND	10		

NOTES:

ng = nanograms
Conc. ug/m3 = concentration in micrograms per cubic meter of air
Qual. = data validation qualifier
ND = none detected at indicated detection limit

TABLE 6. SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN AIR SAMPLES (continued)

Location Number:	9				10				10				10			
Sample Number:	091				021				052				096			
Matrix:	AIR				AIR				AIR				AIR			
Sample Date:	07/11/91				07/08/91				07/09/91				07/11/91			
Lab Sample Number:	A9119705-002A/B				A9119310-002A/B				A9119310-008A/B				A9119705-006A/B			
Analyte Name	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.
Acetone	270	10	2.00E-03		19	10	1.41E-04		28	10	2.08E-04		ND	10		
Methylene Chloride	56	10	4.16E-04		18	10	1.34E-04		23	10	1.71E-04		ND	10		
2-Butanone	30	10	2.23E-04		ND	10			ND	10			ND	10		
1,1,1-Trichloroethane	23	10	1.71E-04		ND	10			ND	10			ND	10		
Benzene	33	10	2.45E-04		ND	10			ND	10			ND	10		
Toluene	220	10	1.63E-03		ND	10			ND	10			19	10	1.41E-04	
Tetrachloroethene	26	10	1.93E-04		ND	10			ND	10			ND	10		
Ethylbenzene	15	10	1.11E-04		ND	10			ND	10			ND	10		
Total Xylenes	69	10	5.12E-04		11	10	8.17E-05		11	10			13	10	9.65E-05	
Styrene	14	10	1.04E-04		ND	10			ND	10			ND	10		

Location Number:	11				11				11				11			
Sample Number:	078				099				118				132			
Matrix:	AIR				AIR				AIR				AIR			
Sample Date:	07/12/91				07/11/91				07/12/91				07/15/91			
Lab Sample Number:	A9119310-005A/B				A9119705-010A/B				A9119705-003A/B				A9119705-007A/B			
Analyte Name	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.
Acetone	34	10	2.52E-04		33	10	2.45E-04		23	10	1.71E-04		18	10	1.34E-04	
Methylene Chloride	58	10	4.31E-04		ND	10			ND	10			ND	10		
2-Butanone	ND	10			ND	10			ND	10			ND	10		
1,1,1-Trichloroethane	ND	10			14	10	1.04E-04		ND	10			ND	10		
Benzene	18	10	1.34E-04		ND	10			ND	10			12	10	8.91E-05	
Toluene	12	10	8.91E-05		22	10	1.63E-04		ND	10			35	10	2.60E-04	
Tetrachloroethene	ND	10			ND	10			ND	10			ND	10		
Ethylbenzene	ND	10			ND	10			ND	10			11	10	8.17E-05	
Total Xylenes	15	10	1.11E-04		24	10	1.78E-04		ND	10			56	10	4.16E-04	
Styrene	ND	10			ND	10			ND	10			ND	10		

NOTES:

ng = nanograms
Conc. ug/m3 = concentration in micrograms per cubic meter of air
Qual. = data validation qualifier
ND = none detected at indicated detection limit

TABLE 6. SUMMARY OF VOLATILE ORGANIC COMPOUNDS DETECTED IN AIR SAMPLES (continue

Location Number:	12				12				12				12			
Sample Number:	076				102				128				136			
Matrix:	AIR				AIR				AIR				AIR			
Sample Date:	07/10/91				07/11/91				07/12/91				07/15/91			
Lab Sample Number:	A9119310-008A/B				A9119705-008A/B				A9119705-011A/B				A9119705-004A/B			
Analyte Name	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.
Acetone	55	10	4.08E-04		25	10	1.86E-04		25	10	1.86E-04		36	10	2.67E-04	
Methylene Chloride	100	10	7.42E-04		1,200*	10	8.91E-03		ND	10			ND	10		
2-Butanone	ND	10			ND	10			16	10	1.19E-04		ND	10		
1,1,1-Trichloroethane	ND	10			ND	10			ND	10			13	10	9.65E-05	
Benzene	31	10	2.30E-04		ND	10			42	10	3.12E-04		20	10	1.49E-04	
Toluene	28	10	2.08E-04		ND	10			57	10	4.23E-04		51	10	3.79E-04	
Tetrachloroethene	ND	10			ND	10			ND	10			ND	10		
Ethylbenzene	ND	10			ND	10			17	10	1.26E-04		19	10	1.41E-04	
Total Xylenes	31	10	2.30E-04		ND	10			43	10	3.19E-04		98	10	7.26E-04	
Styrene	ND	10			ND	10			ND	10			ND	10		

Location Number:	13				13				13			
Sample Number:	108				146				147			
Matrix:	AIR				AIR				BLANK			
Sample Date:	07/11/91				07/18/91				07/18/91			
Lab Sample Number:	A9119310-001A/B				A9120005-002A/B				A9120005-003A/B			
Analyte Name	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.	Results (ng)	Detection Limit	Conc. (ug/m3)	Qual.
Acetone	12	10	8.91E-05		ND	10			ND	10		
Methylene Chloride	63	10	4.68E-04		ND	10			ND	10		
2-Butanone	ND	10			ND	10			ND	10		
1,1,1-Trichloroethane	ND	10			ND	10			ND	10		
Benzene	ND	10			ND	10			ND	10		
Toluene	ND	10			ND	10			ND	10		
Tetrachloroethene	ND	10			ND	10			ND	10		
Ethylbenzene	ND	10			ND	10			ND	10		
Total Xylenes	20	10	1.49E-04		15	10	U		16	10		
Styrene	ND	10			ND	10			ND	10		

NOTES:

ng = nanograms
Conc. ug/m3 = concentration in micrograms per cubic meter of air
Qual. = data validation qualifier
ND = none detected at indicated detection limit

TABLE 7. SUMMARY OF SEMIVOLATILE ORGANIC COMPOUNDS DETECTED IN AIR SAMPLES

Location Number:	6				7				8				12			
Sample Number:	061				082				087				103			
Matrix:	AIR				AIR				AIR				AIR			
Sample Date:	07/07/91				07/11/91				07/11/91				07/11/91			
Lab Sample Number:	059414-0028-SA				059414-0029-SA				059414-0030-SA				059414-0037-SA			
Analyte Name	Results ug/sample	R.L.	Conc. ng/m3	Qual.	Results ug/sample	R.L.	Conc. ng/m3	Qual.	Result ug/sample	R.L.	Conc. ug/m3	Qual.	Result ug/sam	R.L.	Conc. ug/m3	Qual.
Naphthalene	15	10	0.111	J5	14	10	0.104		19	10	0.141		14	10	0.104	
Surrogate	Recovery				Recovery				Recovery				Recovery			
Nitrobenzene-d5	74	%			80	%			72	%			79	%		
2-Fluorobiphenyl	81	%			84	%			82	%			90	%		
Terphenyl-d14	119	%			94	%			92	%			97	%		

ug/sample = micrograms per sample
R.L. = reporting limit
ug/m3 = micrograms per cubic meter of air
Qual. = data validation qualifier
ND = none detected
J5 = qualifier estimated

TABLE 7. SUMMARY OF SEMIVOLATILE ORGANIC COMPOUNDS DETECTED IN AIR SAMPLES (continued)
(PESTICIDES)

Location Number:	8				11			
Sample Number:	066				119			
Matrix	AIR				059414-0036-SA			
Sample Date:	07/07/91				AIR			
Lab Sample Number:	059279-0027-SA				07/12/91			
	Results		Conc.		Result		Conc.	
Analyte Name	ug/sample	R.L.	ug/m3	Qual.	ug/sample	R.L.	ug/m3	Qual.
gamma-BHC (Lindane)	ND	0.20		J5	200	0.20	1.49E+00	J5
Heptachlor	ND	0.20		J5	180	0.20	1.34E+00	J5
Aldrin	ND	0.20		J5	180	0.20	1.34E+00	J5
Dieldrin	0.53	0.20	3.90E-03	J5	550	0.40	4.08E+00	J5
Endrin	0.50	0.20	3.70E-03	J5	520	0.40	3.86E+00	J5
4,4'-DDT	0.47	0.20	3.48E-03	J5	490	0.40	3.64E+00	J5

ug/sample = total micrograms detected in sample
R.L. = reporting limit
ug/m3 = micrograms per cubic centimeter of air
Qual. = data validation qualifier
ND = none detected
J5 = qualifier estimated

TABLE 8. SUMMARY OF METALS DETECTED IN AIR SAMPLES

Location Number:	7				8				8				9			
Sample Number:	083				088				113				093			
Matrix	059414-0007-SA				AIR				AIR				AIR			
Sample Date:	AIR				07/11/91				07/12/91				07/11/91			
Lab Sample Number:	07/11/91				059414-0008-SA				059414-0009-SA				059414-011-SA			
Analyte	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.
Barium	0.025	0.0020	1.86E-01		0.0081	0.0020	6.01E-02		0.0057	0.0020	4.20E-02		0.015	0.0020	1.11E-01	
Chromium	0.011	0.0020	8.17E-02	U	0.0091	0.0020	6.76E-02	U	0.0071	0.0020	5.27E-02	U	0.0099	0.0020	7.35E-02	U
Copper	0.015	0.0040	1.11E-01	U	0.014	0.0040	1.04E-01	U	0.0080	0.0040	5.94E-02	U	1.4	0.0040	1.04E+01	
Lead	0.0071	0.0010		U	0.0078	0.0010	5.79E-02		0.0029	0.0010	2.15E-02	U	0.015	0.0010	1.11E-01	
Mercury	ND	.000080			0.000085	.00008	6.31E-04		ND	.000080			0.00012	.00008	8.90E-04	
Zinc	0.030	0.0040	2.23E-01	U	0.020	0.0040	1.48E-01	U	0.0096	0.0040	7.13E-02	U	0.067	0.0040	4.97E-01	

Location Number:	10				10				10				11			
Sample Number:	117				138				139				120			
Matrix	059414-0012-SA				059414-0013-SA				059414-010-SA				AIR			
Sample Date:	AIR				AIR				AIR				07/12/91			
Lab Sample Number:	07/12/91				07/15/91				07/15/91				059414-014-SA			
Analyte	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.
Barium	0.011	0.0020	8.17E-02		0.0085	0.0020	6.31E-02		0.0088	0.0020	6.53E-02		0.012	0.0020	8.91E-02	
Chromium	0.0085	0.0020	6.31E-02	U	0.0071	0.0020	5.27E-02	U	0.0087	0.0020	6.46E-02	U	0.0086	0.0020	6.38E-02	U
Copper	0.032	0.0040	2.30E-01		0.044	0.0040	3.27E-01		0.025	0.0040	1.86E-01		0.011	0.0040	8.17E-02	U
Lead	0.0073	0.0010	5.42E-02		0.0062	0.0010	4.60E-02	U	0.0065	0.0010	4.83E-02		0.0098	0.0010	7.28E-02	
Mercury	0.00012	.00008	8.90E-04		ND	.000080			ND	.000080			0.00010	.00008	7.42E-04	
Zinc	0.023	0.0040	1.71E-01	U	0.020	0.0040	1.48E-01	U	0.017	0.0040	1.26E-01	U	0.019	0.0040	1.41E-01	U

NOTES:

D.L. = detection limit
ug/m3 = micrograms per cubic meter of air
Qual. = data validation qualifier
ND = none detected
U = qualifier none detected

TABLE 8. SUMMARY OF METALS DETECTED IN AIR SAMPLES (continued)

Location Number:	11
Sample Number:	137
Matrix	AIR
Sample Date:	07/15/91
Lab Sample Number:	059414-0015-SA

Analyte	Result (total mg)	D.L.	Conc. (ug/m3)	Qual.
Barium	0.020	0.0020	1.48E-01	
Chromium	0.0088	0.0020	6.53E-02	U
Copper	0.037	0.0040	2.75E-01	
Lead	0.021	0.0010	1.56E-01	
Mercury	0.00013	.00008	9.65E-04	
Zinc	0.039	0.0040	2.90E-01	U

NOTES:

D.L. = detection limit
ug/m3 = micrograms per cubic meter of air
Qual. = data validation qualifier
ND = none detected
U = qualifier none detected

TABLE 9. SUMMARY OF ASBESTOS DETECTED IN AIR SAMPLES

Location Number	Sample Number	Lab ID Number	Concentration s/cc
1	018-910708	5635-01	0.014
3	058-910710	5635-03	0.005
6	063-910710	5635-06	0.014
8	114-910712	5635-10	0.005
11	074-910710	5635-17	0.005
11	121-910712	5635-19	0.014
12	105-910711	5635-22	0.009
12	126-910712	5635-23	0.005
12	130-910715	5635-24	0.022

s/cc = structures per cubic centimeter of air

Table 10. Summary of SFO Meteorological Data

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
June 24					
1	53	280	81.8	30.01	12
2	54	290	76.6	30.01	17
3	54	260	76.6	30.00	15
4	54	280	71.6	30.00	14
5	54	270	71.6	30.00	15
6	54	260	76.6	30.00	13
7	55	280	71.7	30.01	12
8	55	280	71.7	30.01	13
9	55	290	71.7	30.02	16
10	55	260	71.7	30.03	16
11	56	260	67.1	30.04	15
12	56	280	67.1	30.05	15
13	57	270	62.9	30.05	15
14	58	270	55.0	30.04	18
15	59	270	51.6	30.04	17
16	59	270	51.6	30.03	19
17	60	270	48.4	30.02	15
18	59	260	51.6	30.02	13
19	58	250	58.9	30.03	12
20	56	250	62.7	30.03	13
21	55	260	67.0	30.04	15
22	56	260	67.1	30.04	16
23	55	280	67.0	30.04	16
24	55	250	71.7	30.03	13

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
June 25					
1	55	270	71.7	30.03	11
2	56	250	67.1	30.02	11
3	55	250	71.7	30.02	11
4	55	280	71.7	30.01	11
5	55	270	71.7	30.03	12
6	55	300	67.0	30.03	13
7	55	300	67.0	30.03	12
8	55	290	67.0	30.04	14
9	57	260	58.8	30.05	14
10	57	300	62.9	30.07	12
11	59	270	51.6	30.07	13
12	61	270	45.4	30.06	17
13	63	270	39.9	30.07	16
14	61	280	42.4	30.08	20
16	62	290	42.5	30.07	17
17	61	290	45.4	30.05	15
18	59	280	55.2	30.03	18
19	56	270	67.1	30.02	16
20	55	270	71.7	30.02	17
21	55	270	71.7	30.02	14
22	55	280	71.7	30.02	13
23	54	270	76.6	30.01	16
24	53	280	81.8	30.00	12

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
June 26					
1	53	270	81.8	29.99	12
2	53	260	81.8	29.99	14
3	53	260	81.8	29.99	13
4	53	290	76.5	29.99	10
5	53	270	81.8	29.99	13
6	53	280	81.8	30.01	11
7	53	270	81.8	30.02	12
8	54	270	76.6	30.02	14
9	55	270	71.7	30.02	13
10	56	280	62.7	30.01	15
11	57	280	62.9	30.01	14
12	59	280	51.6	30.00	18
13	59	280	51.6	29.99	15
14	57	280	58.8	30.00	17
15	58	270	55.0	29.98	11
16	57	270	58.8	29.97	11
17	56	250	62.7	29.96	9
18	51	240	93.5	29.94	5
19	57	120	62.9	29.92	6
20	56	200	67.1	29.92	4
21	51	0	93.5	29.91	0
22	57	140	71.9	29.88	6
23	56	220	76.7	29.87	3
24	57	290	71.9	29.84	3

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
June 27					
1	54	320	87.6	29.83	9
2	54	310	93.6	29.82	7
3	54	330	87.6	29.81	3
4	54	330	87.6	29.80	4
5	55	250	87.6	29.80	0
6	55	0	87.6	29.80	4
7	56	110	87.7	29.81	6
8	57	150	82.1	29.82	3
9	57	120	87.7	29.82	0
10	60	0	72.7	29.82	3
11	62	330	67.8	29.82	6
12	63	360	59.6	29.82	6
13	63	40	52.2	29.82	5
14	64	130	59.7	29.82	0
15	64	0	59.7	29.81	10
16	64	290	68.0	29.81	12
17	61	300	82.4	29.81	11
18	61	310	77.2	29.80	8
19	62	240	67.8	29.81	8
20	61	230	72.3	29.80	6
21	61	260	67.7	29.82	8
22	59	230	82.2	29.83	5
23	59	210	82.2	29.82	4
24	60	170	77.1	29.81	8

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
June 28					
1	60	180	77.1	29.81	5
2	60	10	87.9	29.80	6
3	59	350	93.7	29.80	6
4	59	10	93.7	29.79	3
5	58	6	100.0	29.79	7
6	58	2	100.0	29.80	6
7	59	10	93.7	29.81	0
8	59	0	93.7	29.82	0
9	60	0	87.9	29.82	7
10	61	3	87.9	29.82	0
11	62	0	77.3	29.83	5
12	64	190	63.8	29.84	15
13	63	180	63.6	29.84	12
14	62	190	67.8	29.85	7
15	62	250	67.8	29.86	10
16	60	210	82.3	29.87	10
17	61	230	72.3	29.87	12
18	59	230	82.2	29.88	10
19	58	220	82.2	29.89	8
20	58	220	82.2	29.90	9
21	57	240	82.1	29.92	9
22	58	250	76.9	29.93	7
23	58	270	72.0	29.93	6
24	58	240	72.0	29.94	4

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
June 29					
1	58	260	72.0	29.94	0
2	58	0	72.0	29.94	0
3	58	0	76.9	29.94	5
4	58	210	76.9	29.95	0
5	58	0	76.9	29.97	5
6	58	320	76.9	29.98	5
7	59	310	72.1	30.00	11
8	60	310	67.6	30.02	3
9	61	280	63.4	30.03	11
10	63	310	59.6	30.03	8
11	65	300	49.1	30.05	11
12	67	300	46.3	30.05	14
13	67	320	43.3	30.05	14
14	67	290	40.6	30.05	15
15	68	300	40.7	30.05	15
16	65	290	52.5	30.04	16
17	64	280	52.3	30.03	18
18	62	280	52.0	30.03	17
19	60	300	63.2	30.02	16
20	57	290	71.9	30.02	15
21	56	290	76.7	30.03	11
22	56	300	82.0	30.04	10
23	56	300	82.0	30.04	9
24	56	310	82.0	30.03	3

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
June 30					
1	55	300	82.0	30.02	0
2	56	0	82.0	30.01	0
3	54	0	81.9	30.01	0
4	55	0	87.6	30.01	4
5	55	260	82.0	30.01	3
6	57	0	76.8	30.02	0
7	62	0	63.5	30.02	4
8	65	4	56.1	30.02	5
9	69	7	46.6	30.01	4
10	72	4	34.0	30.00	6
11	73	5	36.5	29.99	5
12	78	1	28.8	29.97	17
13	80	290	22.4	29.97	16
14	80	300	21.0	29.95	17
15	81	290	17.3	29.93	19
16	79	300	16.0	29.92	18
17	78	290	15.8	29.90	16
18	77	300	16.8	29.89	15
19	70	300	31.5	29.89	15
20	65	310	43.0	29.89	11
21	64	310	45.8	29.90	9
22	63	300	48.8	29.91	10
23	62	300	52.0	29.98	6
24	61	300	55.5	29.98	5

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 1					
1	61	300	55.5	29.87	0
2	62	0	55.6	29.86	5
3	60	300	63.2	29.86	0
4	60	0	63.2	29.86	0
5	62	0	59.4	29.87	5
6	63	310	55.8	29.88	0
7	68	0	49.6	29.89	5
8	71	4	44.0	29.89	5
9	73	4	36.5	29.89	6
10	78	2	28.8	29.88	7
11	78	2	32.8	29.88	8
12	81	2	29.3	29.86	12
13	90	310	13.4	29.85	16
14	85	300	17.9	29.84	18
15	83	300	18.8	29.82	20
16	81	300	21.1	29.81	19
17	76	310	26.7	29.80	18
18	74	300	28.2	29.80	16
19	73	300	29.9	29.80	15
20	67	300	43.3	29.80	13
21	64	300	52.3	29.83	13
22	62	300	59.4	29.83	10
23	60	300	63.2	29.83	9
24	60	300	63.2	29.83	6

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 2					
1	60	290	63.2	29.82	8
2	59	300	67.5	29.81	9
3	58	290	72.0	29.82	7
4	58	290	72.0	29.82	7
5	57	290	76.8	29.84	5
6	62	310	59.4	29.85	4
7	68	30	43.5	29.86	4
8	69	30	49.7	29.87	5
9	75	40	34.5	29.87	6
10	80	40	29.1	29.88	8
11	79	20	35.1	29.87	12
12	85	310	17.9	29.87	14
13	83	310	20.1	29.87	19
14	83	300	20.1	29.86	19
15	79	300	23.8	29.86	18
16	74	310	30.1	29.85	18
17	71	310	36.1	29.85	17
18	68	320	40.7	29.86	15
19	63	300	55.8	29.87	16
20	59	300	72.1	29.87	11
21	59	300	72.1	29.89	10
22	57	300	82.1	29.90	11
23	57	300	82.1	29.90	10
24	56	300	82.0	29.89	9

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 3					
1	56	300	82.0	29.89	9
2	55	300	87.6	29.89	9
3	55	300	93.6	29.89	9
4	55	300	93.6	29.89	8
5	55	300	93.6	29.90	4
6	58	270	76.9	29.91	4
7	63	260	59.6	29.92	6
8	67	10	52.8	29.92	9
9	69	330	43.7	29.91	13
10	69	310	40.9	29.91	14
11	71	310	36.1	29.91	17
12	72	310	36.3	29.90	18
13	71	310	38.6	29.89	21
14	71	310	38.6	29.88	19
15	70	310	41.0	29.86	19
16	68	300	43.5	29.85	21
17	65	310	52.5	29.84	19
18	63	310	53.6	29.85	19
19	60	310	72.2	29.85	18
20	56	310	82.0	29.86	16
21	56	300	82.0	29.86	13
22	55	300	87.6	29.87	13
23	54	310	93.6	29.88	13
24	54	310	93.6	29.87	10

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 4					
1	54	310	93.6	29.86	11
2	54	300	87.6	29.86	11
3	53	300	93.6	29.85	10
4	53	310	93.6	29.85	11
5	53	310	93.6	29.85	10
6	54	300	93.6	29.87	10
7	57	300	76.8	29.88	9
8	60	320	57.6	29.87	10
9	62	310	59.4	29.87	12
10	64	320	52.3	29.86	12
11	65	320	49.1	29.86	14
12	67	320	43.3	29.84	14
13	69	310	38.3	29.83	19
14	69	310	38.3	29.81	16
15	67	310	43.3	29.80	21
16	66	310	46.1	29.78	18
17	64	310	52.3	29.77	19
18	62	310	59.4	29.76	18
19	59	310	67.5	29.77	18
20	57	300	76.8	29.77	15
21	56	310	87.7	29.78	14
22	56	300	87.7	29.79	11
23	56	310	87.7	29.80	10
24	55	310	93.6	29.79	8

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 5					
1	55	300	93.6	29.78	8
2	55	300	87.6	29.78	8
3	54	300	93.6	29.78	4
4	53	290	100.0	29.78	0
5	56	0	87.7	29.79	4
6	57	290	87.7	29.81	0
7	58	0	82.2	29.82	5
8	60	10	77.1	29.82	7
9	63	60	67.9	29.82	9
10	66	30	56.2	29.83	10
11	66	20	56.2	29.83	10
12	67	20	52.8	29.82	11
13	69	30	46.6	29.82	10
14	71	40	44.0	29.81	7
15	73	60	38.9	29.80	9
16	74	330	34.3	29.79	11
17	72	320	36.3	29.78	10
18	69	320	40.9	29.79	11
19	64	340	55.9	29.79	11
20	61	320	63.4	29.80	9
21	59	320	72.1	29.82	9
22	58	330	76.9	29.83	8
23	57	310	82.1	29.83	8
24	56	300	87.7	29.84	7

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 6					
1	56	300	82.0	29.84	8
2	56	290	87.7	29.83	7
3	57	290	82.1	29.83	4
4	58	210	76.9	29.84	3
5	57	230	82.1	29.85	3
6	59	230	72.1	29.87	7
7	61	170	72.3	29.89	8
8	64	120	59.7	29.89	8
9	65	90	56.1	29.90	8
10	67	60	52.8	29.90	8
11	68	20	52.9	29.91	10
12	70	40	49.9	29.91	10
13	72	60	41.4	29.91	4
14	75	60	34.5	29.90	4
15	76	320	30.4	29.89	9
16	74	80	34.3	29.89	16
17	69	320	33.7	29.88	13
18	66	300	49.3	29.89	10
19	64	300	52.3	29.89	10
20	61	310	63.4	29.91	11
21	59	300	72.1	29.93	5
22	59	290	72.1	29.94	5
23	59	290	67.5	29.94	6
24	59	340	72.1	29.94	8

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 7					
1	58	330	76.9	29.93	7
2	59	280	72.1	29.94	6
3	59	250	72.1	29.94	8
4	60	290	57.6	29.94	5
5	57	250	76.8	29.95	5
6	58	240	76.9	29.96	5
7	60	220	57.6	29.97	7
8	61	200	67.7	29.97	9
9	67	150	49.4	29.97	12
10	64	320	59.7	29.97	15
11	65	340	56.1	29.98	11
12	70	270	41.0	29.98	18
13	66	320	49.3	29.96	17
14	68	300	43.5	29.95	19
15	67	310	46.3	29.94	18
16	66	320	49.3	29.93	17
17	66	300	46.1	29.92	17
18	63	310	55.8	29.93	14
19	61	300	63.4	29.94	13
20	58	300	72.0	29.95	12
21	57	300	76.8	29.96	11
22	57	280	76.8	29.98	10
23	56	290	82.0	29.98	8
24	57	290	76.8	29.97	7

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 8					
1	57	280	76.8	29.96	10
2	56	280	82.0	29.95	8
3	55	280	87.6	29.96	9
4	54	280	87.6	29.96	10
5	55	280	82.0	29.97	10
6	55	280	82.0	29.97	8
7	56	280	71.8	29.98	9
8	58	290	67.3	29.99	11
9	61	310	59.3	29.99	10
10	64	300	52.3	29.99	12
11	67	340	43.3	29.99	16
12	67	310	43.3	29.99	15
13	66	290	43.2	29.99	14
14	68	260	38.1	29.99	17
15	66	280	43.2	29.97	14
16	66	280	43.2	29.96	14
17	64	280	45.8	29.95	14
18	62	280	52.0	29.96	11
19	59	270	63.1	29.96	10
20	57	260	71.9	29.96	9
21	57	250	67.2	29.98	8
22	56	240	76.7	29.98	9
23	56	270	76.7	29.98	9
24	56	270	71.8	29.97	9

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 9					
1	55	270	76.7	29.97	11
2	54	250	81.9	29.96	11
3	54	270	81.9	29.96	11
4	54	260	81.9	29.97	9
5	53	270	87.5	29.97	10
6	53	240	87.5	29.97	11
7	54	270	81.9	29.99	9
8	54	250	81.9	30.00	10
9	55	270	76.7	30.00	12
10	56	270	67.1	30.00	13
11	57	290	62.9	30.00	14
12	60	290	55.3	30.00	13
13	62	260	48.7	29.99	14
14	63	260	45.7	29.99	14
15	64	290	42.9	29.87	15
16	62	280	48.7	29.97	15
17	60	290	51.7	29.96	12
18	57	290	67.2	29.96	15
19	55	270	71.7	29.96	11
20	54	270	76.6	29.97	11
21	54	280	76.6	29.97	7
22	54	290	76.6	29.97	5
23	54	280	76.6	29.97	6
24	53	250	81.8	29.96	10

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 10					
1	54	270	76.6	29.95	7
2	53	270	76.5	29.94	3
3	53	220	76.5	29.94	5
4	52	230	81.7	29.94	5
5	51	300	87.4	29.95	4
6	52	220	87.4	29.96	0
7	58	0	63.0	29.97	5
8	61	80	51.9	29.99	4
9	64	160	42.9	29.98	15
10	64	320	40.1	29.99	17
11	64	310	40.1	29.99	17
12	65	310	40.2	29.99	16
13	64	300	42.9	29.98	18
14	65	310	40.2	29.98	17
15	64	310	42.9	29.97	16
16	62	280	48.7	29.97	14
17	62	290	48.7	29.96	14
18	60	310	55.3	29.96	12
19	57	300	62.9	29.97	10
20	55	300	71.7	29.97	9
21	55	280	71.7	29.98	7
22	55	270	71.7	29.99	6
23	54	310	76.6	29.98	3
24	54	290	76.6	29.98	4

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 11					
1	54	250	76.6	29.98	6
2	53	290	81.8	29.97	6
3	53	270	81.8	29.96	5
4	52	260	81.7	29.96	4
5	52	260	81.7	29.97	4
6	53	240	81.8	29.98	3
7	57	190	62.9	29.99	4
8	61	80	59.3	29.99	6
9	62	30	55.6	29.98	7
10	65	10	46.0	29.99	11
11	63	310	48.8	29.99	10
12	67	350	40.6	29.98	10
13	70	320	33.7	29.98	15
14	69	320	35.8	29.98	18
15	69	320	33.5	29.97	21
16	65	310	40.2	29.97	17
17	63	310	45.7	29.96	16
18	61	310	51.9	29.97	15
19	57	300	67.2	29.98	13
20	55	300	76.7	29.99	11
21	55	300	82.0	30.00	10
22	55	310	76.7	30.02	10
23	54	310	93.6	30.01	9
24	54	300	87.6	30.01	4

Table 10. Summary of SFO Meteorological Data (continued)

Hour	Temperature (°F)	Direction (degrees)	Relative Humidity (%)	Barometric Pressure (inches Hg)	Speed (knots)
July 12					
1	54	300	87.6	30.01	8
2	53	310	93.6	30.01	8
3	53	310	93.6	30.01	7
4	54	300	81.9	30.01	7
5	54	300	87.6	30.02	8
6	54	310	81.9	30.02	8
7	56	300	76.7	30.02	10
8	59	310	63.1	30.03	11
9	61	320	59.3	30.03	12
10	64	340	49.0	30.03	14
11	67	310	37.9	30.03	15
12	69	300	35.8	30.03	17
13	70	290	31.5	30.03	14
14	67	320	37.9	30.04	14
15	65	290	43.0	30.04	16
16	63	300	52.2	30.04	18
17	61	270	55.5	30.05	14
18	59	280	72.1	30.05	16
19	58	270	82.2	30.04	13
20	58	250	82.2	30.05	11
21	58	260	87.8	30.06	11
22	58	280	82.2	30.06	6
23	57	290	87.7	30.06	9
24	57	270	87.7	30.05	8

ILLUSTRATIONS

SAN FRANCISCO BAY

LOCATION 6 (DOWNWIND)

WET STATION

IR-7

LOCATION 12 (UPWIND BACKGROUND)

IR-10

IR-20

IR-6

LOCATION 7 (DOWNWIND)

IR-1/21

LOCATION 1 (WITHIN AREA)

IR-4

LOCATION 4 (DOWNWIND)

IR-9

LOCATION 9 (DOWNWIND)

IR-22

LOCATION 10 (DOWNWIND PERIMETER)

IR-12

LOCATION 11 (UPWIND BACKGROUND)

LOCATION 5 (DOWNWIND)

IR-5

MET STATION

IR-2

IR-13

IR-8

LOCATION 2 (DOWNWIND)

IR-14

IR-15

IR-3

IR-11

IR-17

LOCATION 3 (DOWNWIND)

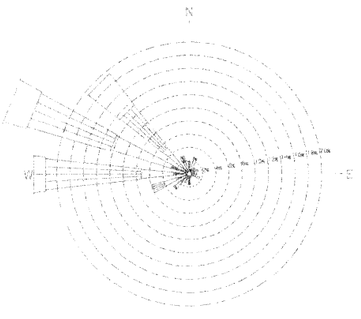
LOCATION 8 (DOWNWIND PERIMETER)

SAN FRANCISCO BAY

EXPLANATION

- Sample Locations
- Meteorological Stations
- IR Sites

FREQUENCY OF WIND SPEED AND DIRECTION



WINDROSE
HUNTERS POINT ANNEX
SFO METEOROLOGICAL DATA
(U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Weather Service)

0 300 600

SCALE IN FEET

DRAFT

HPAWIND.DWG

Harding Lawson Associates
Engineering and Environmental Services

Meteorological Stations and Air Sample Locations
Air Sampling Report
Hunters Point Annex
San Francisco, California

PLATE 1

DRAWN: CEG | JOB NUMBER: 10639.079.03 | APPROVED: | DATE: 10/91 | REVISED DATE:

DISTRIBUTION

DRAFT
AIR SAMPLING REPORT
NAVAL STATION, TREASURE ISLAND
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA
January 2, 1992

Copy No. ___

		Copy No.
26 copies:	Installation Restoration Branch, Code 1811 Western Division Naval Facilities and Engineering Command 900 Commodore Drive, Building 101 San Bruno, California 94066 Attention: Ms. Louise Lew (Code 1811LL)	1 - 26
2 copies:	PRC Environmental Management, Inc. 120 Howard Street, Suite 700 San Francisco, California 94705-1622 Attention: Dr. Gary Welshans	27-28
3 copies:	Harding Lawson Associates	29-31
1 copy:	HLA Master File	32
1 copy:	HLA Corporate Library	33

PAD/CC/DFL/RV/lah/J20532-H

QUALITY CONTROL REVIEWER

David F. Leland, P.E.
Associate Engineer